The HEET Grid Game

BALANCE is like BINGO!



The Thermal (Energy) Highway©

IGSHPA & GreyEdge Group

Energy *harvested*, *moved*, and *reused*

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801-942-6100

gewbank@greyedgegroup.com

gsexton@greyedgegroup.com

csmith@greyedgegroup.com

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Courtesy of The GreyEdge Group©

GROUND HEAT EXCHANGER FINANCING OPTIONS

- OWNER PAYS FIRST COSTS
- OWNER USES DEBT FOR FIRST COST
- THIRD PARTY FINANCING
- THIRD PARTY OWNERSHIP
- PACE – TAX ASSESSMENT
- UTILITIES
  - RATE BASED TARIFF
  - UACE©
  - DEMAND SIDE MANAGEMENT
  - ENERGY EFFICIENCY PROGRAMS

REBATES & INCENTIVES

- UTILITIES
  - DSM PROGRAMS
  - EE PROGRAMS
- LOCAL, STATE AND FEDERAL TAX CREDITS
- FEDERAL DEPRECIATION (COMMERCIAL & INDUSTRIAL)

REBATES & INCENTIVES

- LOCAL, STATE AND FEDERAL TAX CREDITS
  - RESIDENTIAL
  - COMMERCIAL
- FEDERAL DEPRECIATION (COMMERCIAL & INDUSTRIAL)
  - USES THE GENERAL DEPRECIATION SYSTEM (GDS)
  - MODIFIED ACCELERATED COST RECOVERY SYSTEM (MACRS)
  - THE PRIMARY DEPRECIATION METHOD USED FOR TAX PURPOSES. ONE TAKES A LARGER ANNUAL DEDUCTION IN THE FIRST YEARS AND LESS IN LATER YEARS. GROUND SOURCE HEAT EXCHANGERS ARE USUALLY 5 YEARS MACRS.
  - SECTION 179 ONE CAN DEDUCT THE FULL COST OF ASSETS UP TO $500,000 IN THE YEAR OF THE PURCHASE
  - UTILITIES REBATES AND INCENTIVES

THE ELUSIVE "*NEGAWATT*" *AND GSHPS*

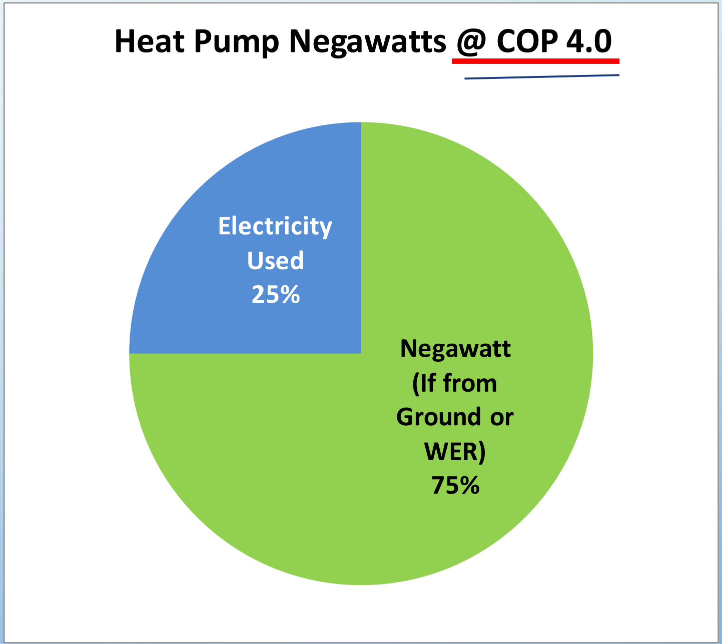
NEGAWATT POWER (LOVINS 1989) -

- A THEORETICAL UNIT
  OF POWER REPRESENTING AN AMOUNT OF ENERGY (MEASURED IN WATTS) SAVED AS A DIRECT RESULT OF ENERGY CONSERVATION OR INCREASED ENERGY EFFICIENCY.

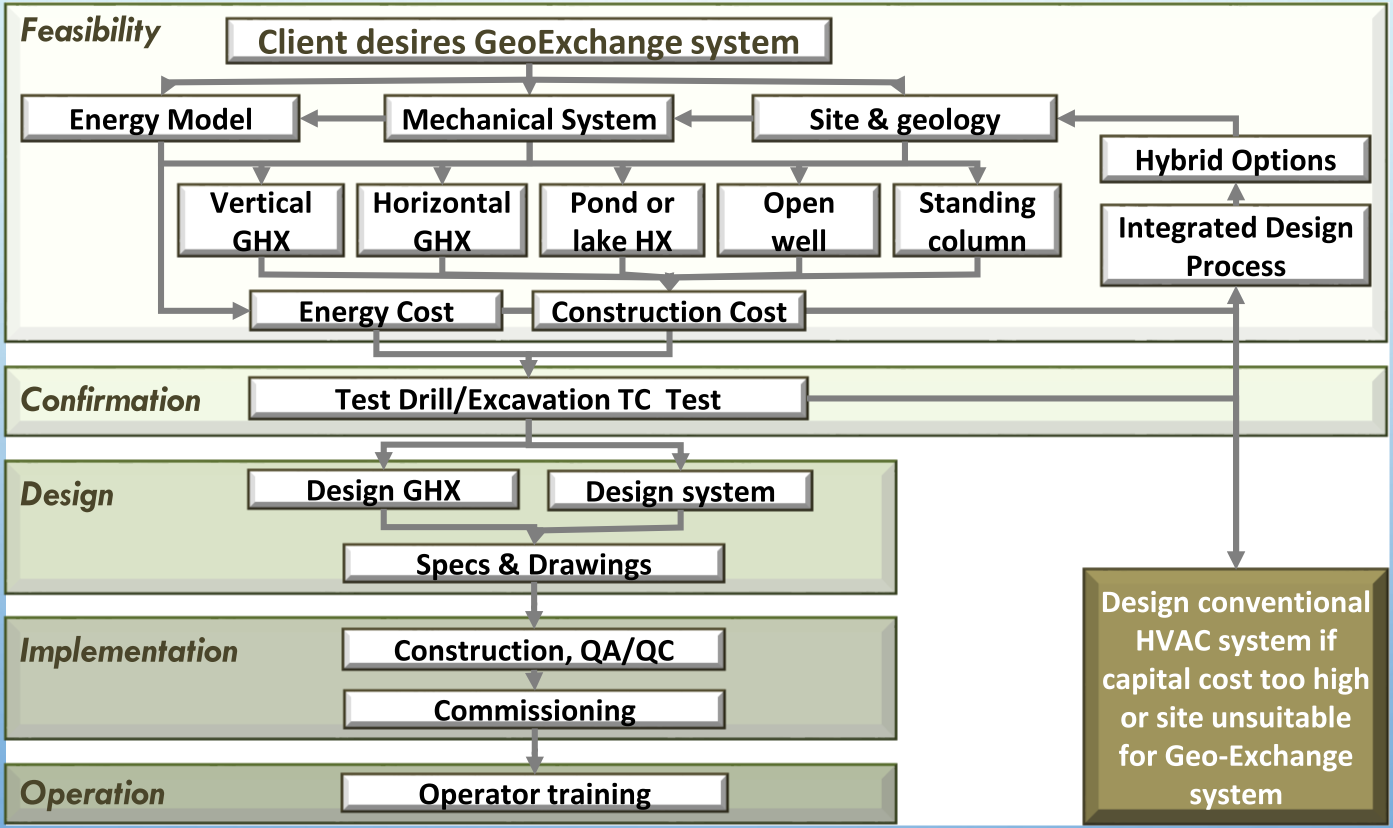
NEGAWATT MARKET –

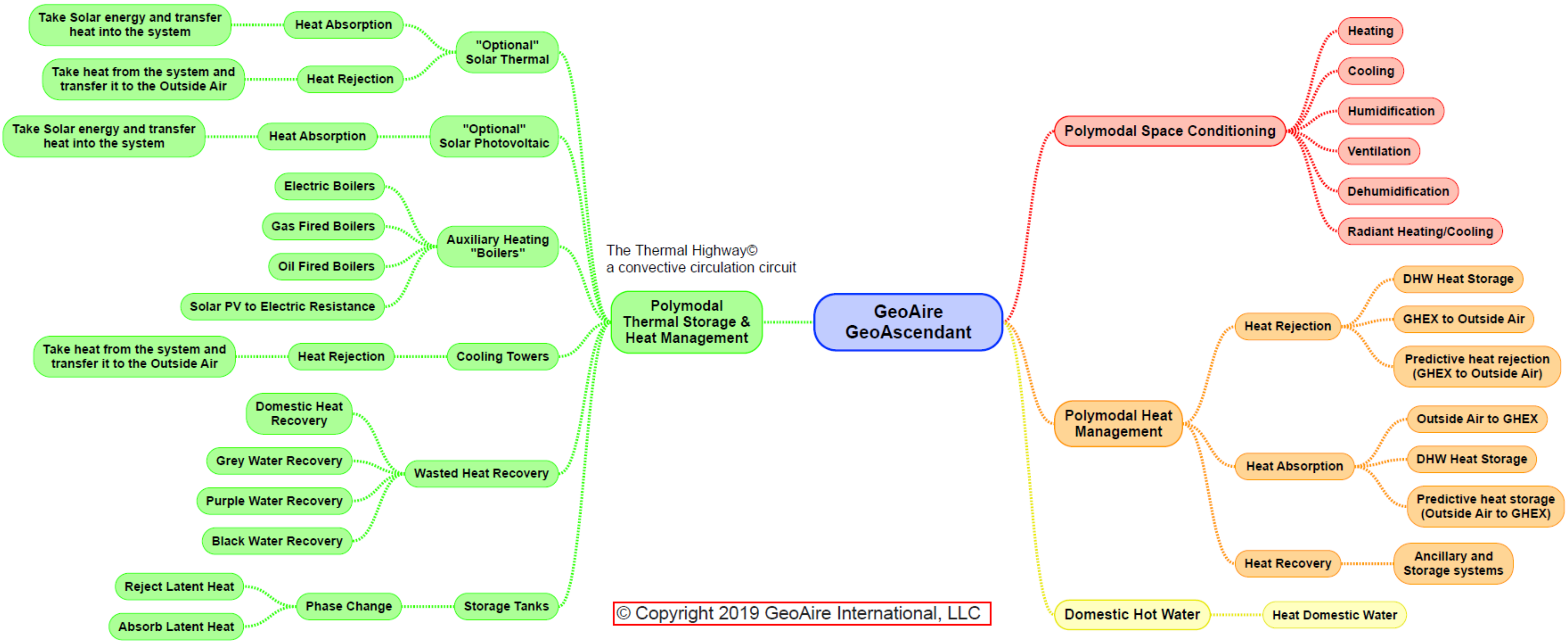
- A NEGAWATT MARKET IS A SECONDARY MARKET IN WHICH SAVED ENERGY IS ALLOCATED FROM ONE CONSUMER TO ANOTHER CONSUMER.

- <u>NEGAWATTS COULD BE TRADED AS A COMMODITY ACROSS TIME AND SPACE.</u>



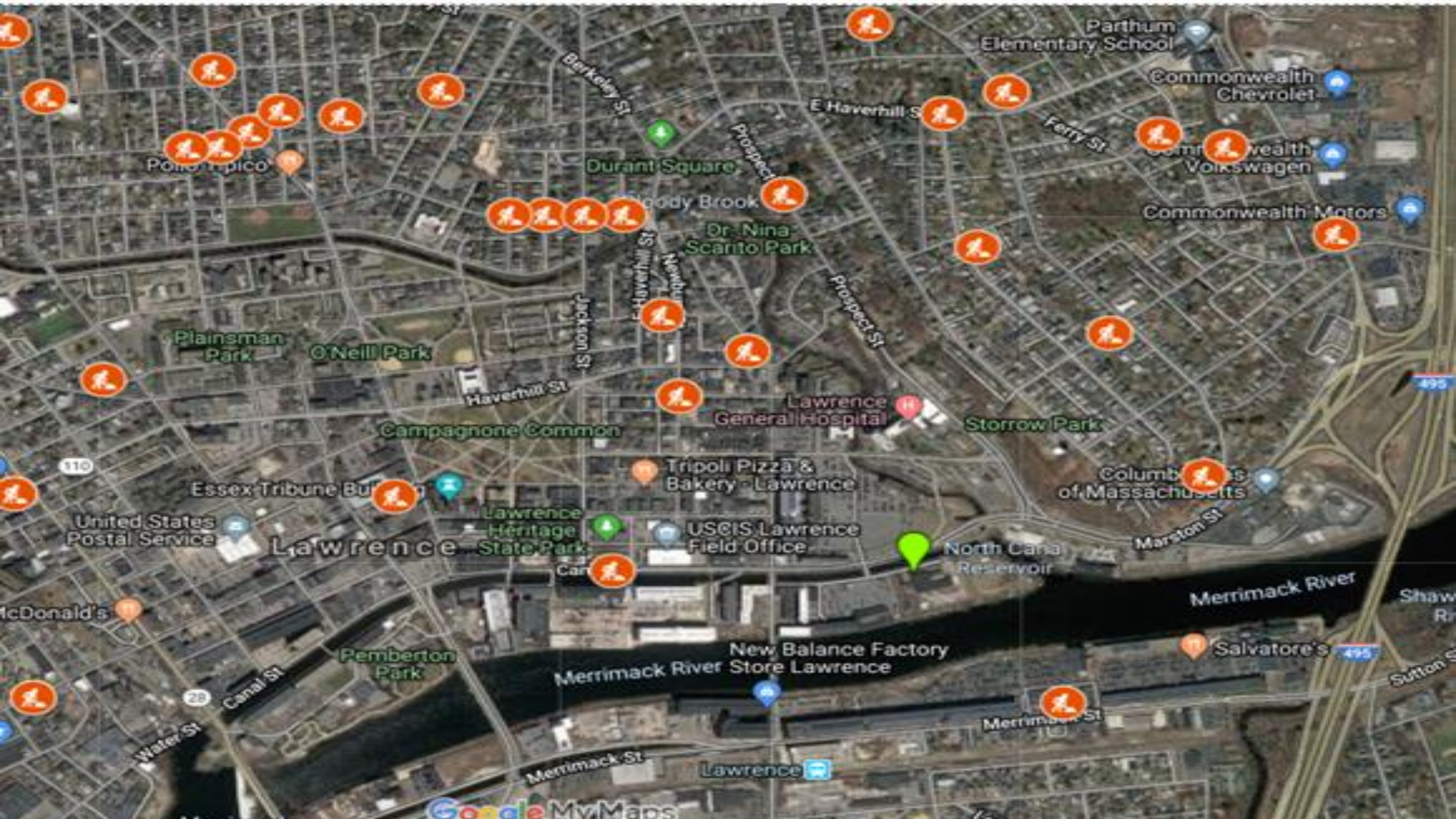
DESIGN PROCESS FOR A GSHP/GHEX SYSTEM




Take Solar energy and transfer heat into the system
Heat Absorption
"Optional" Solar Thermal
Take heat from the system and transfer it to the Outside Air
Heat Rejection
Take Solar energy and transfer heat into the system
Heat Absorption
"Optional" Solar Photovoltaic
Electric Boilers
Gas Fired Boilers
Oil Fired Boilers
Solar PV to Electric Resistance
Auxiliary Heating "Boilers"
Take heat from the system and transfer it to the Outside Air
Heat Rejection
Cooling Towers
Domestic Heat Recovery
Grey Water Recovery
Purple Water Recovery
Black Water Recovery
Wasted Heat Recovery
Reject Latent Heat
Absorb Latent Heat
Phase Change
Storage Tanks
The Thermal Highway©
a convective circulation circuit
Polymodal Thermal Storage & Heat Management
GeoAire GeoAscendant
Polymodal Space Conditioning
Heating
Cooling
Humidification
Ventilation
Dehumidification
Radiant Heating/Cooling
Polymodal Heat Management
Heat Rejection
DHW Heat Storage
GHEX to Outside Air
Predictive heat rejection (GHEX to Outside Air)
Heat Absorption
Outside Air to GHEX
DHW Heat Storage
Predictive heat storage (Outside Air to GHEX)
Heat Recovery
Ancillary and Storage systems
Domestic Hot Water
Heat Domestic Water

LAWENCE PROJECT



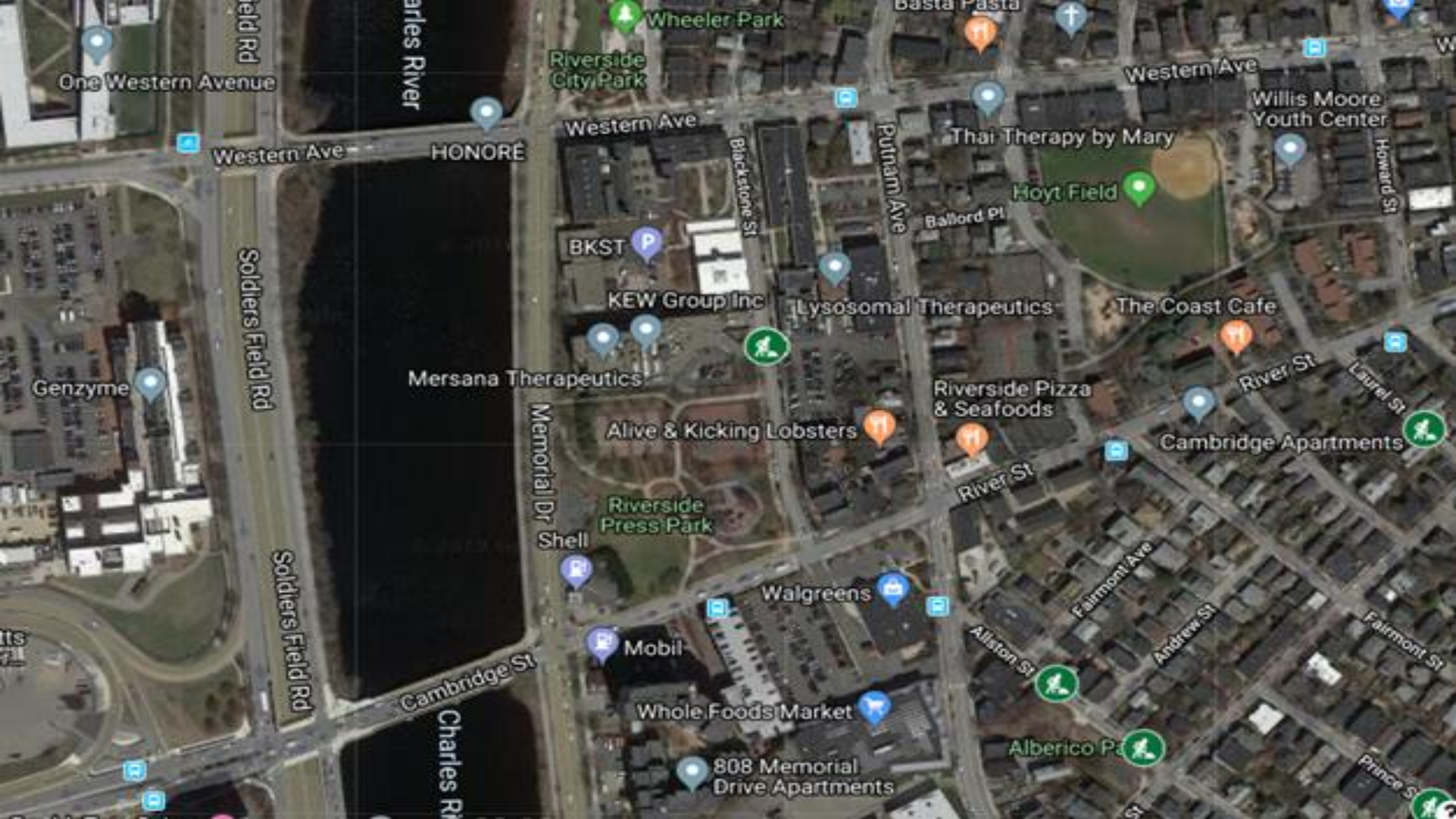


Parthum Elementary School
Commonwealth Chevrolet
Commonwealth Volkswagen
Commonwealth Motors
Berkeley St
E Haverhill St
Ferry St
Prospect St
Durant Square
Dr. Nina Scarito Park
Haverhill St
Newbury St
Jackson St
Plainsman Park
O'Neill Park
Lawrence General Hospital
Storrow Park
Campagnone Common
Tripoli Pizza & Bakery - Lawrence
Essex Tribune Building
United States Postal Service
Lawrence
Lawrence Heritage State Park
USCIS Lawrence Field Office
North Canal Reservoir
Marston St
Merrimack River
McDonald's
Pemberton Park
New Balance Factory Store Lawrence
Salvatore's
Canal St
Water St
Merrimack St
495
110
28
Google My Maps


St Michael Cemetery
City Soil
Boston Fried
Canterbury St
Clark/Cooper Community Garden
Mass Audubon's Boston Nature Center and...
W Main St
Senator Bolling Cir
Brookview House
Harvard St
Hansborough St
Carlford Ct
Johnston Rd
Wendy's
Walk Hill Florist
University Rd
Industrial Rd
Falcon Ln
Nu Flav
Wilcock St
Paine St
Walk Hill St
Johnson Rd
Courtland Rd
Havelock St
Monahan Rd
Bon Appetit
Deering Rd
Flames
Christ Apostolic Church Mount Zion 1
Frontenac
Mt. Hope Cemetery
Westmore Rd
Ali's Roti
203
Wellington Hill St
Hillsboro Rd
Rose African Hair Braiding
Gilmer St
Hazelton St
Young Achievers Science And Math Pilot School
New Calvary Cemetery
Hosmer St
Step N Out Mart



University Rd
Industrial Rd
W Main St
Falcon Ln
Estella
Oak St
Johnson Rd
W Main St
Harvard St
Courtland Rd
Monahan Rd
Deering Rd
Walk Hill St
Harvard St
Westmore Rd
MassBiologics
State Public Health Campus
Wellington Hill St
Mt. Hope Cemetery
Walk Hill St
Westmore Rd
Ormond St
Christ Apostolic Church Mount Zion 1
Cleomene
Hillsboro Rd



Basta Pasta
Wheeler Park
Riverside City Park
One Western Avenue
Charles River
Western Ave
Western Ave
Western Ave
HONORÉ
Willis Moore Youth Center
Thai Therapy by Mary
Blackstone St
Putnam Ave
Hoyt Field
Howard St
Ballord Pl
BKST
KEW Group Inc
Lysosomal Therapeutics
The Coast Cafe
Soldiers Field Rd
Genzyme
Mersana Therapeutics
Memorial Dr
Riverside Pizza & Seafoods
River St
Laurel St
Alive & Kicking Lobsters
Cambridge Apartments
River St
Riverside Press Park
Shell
Walgreens
Fairmont Ave
Andrew St
Allston St
Fairmont St
Mobil
Soldiers Field Rd
Cambridge St
Whole Foods Market
Charles River
808 Memorial Drive Apartments



BKST
KEW Group Inc
Lysosomal Therapeutics
The Coast Cafe
Mersana Therapeutics
Soldiers Field Rd
Memorial Dr
Riverside Pizza & Seafoods
Alive & Kicking Lobsters
River St
Laurel St
Cambridge Apartments
Riverside Press Park
Shell
Walgreens
Fairmont Ave
Andrew St
Fairmont St
Allston St
Mobil
Cambridge St
Charles River
Whole Foods Market
Alberico Pa
808 Memorial Drive Apartments
Prince St
Thermo Fisher Scientific
Pleasant St
D & D Convenienc
Google My Maps

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gewbank@greyedgegroup.com

gsexton@greyedgegroup.com

csmith@greyedgegroup.com

Questions?

Comfort from the ground up

MAIN ROOM

ECTOGRID: THERMAL MANAGEMENT CASE - *DAN EPEL*
BENEFICIAL ELECTRIFICATION - *GARRY SEXTON*
STATE LEVEL ENERGY TRANSITION – *JERRY ACTON*

BREAK OUT DISCUSSION GROUPS

GEOTHERMAL INDUSTRY - *JOHN CIOVACCO*
LEGISLATIVE & REGULATORY - *REP. EHRLICH*
PREPARING COMMUNITIES FOR ELECTRIFICATION - *PROF. PHILLIPS*

ectogrid™

shared energy for a sustainable city

Maria Malm Skarin
Business Development Manager - ectogrid™
E.ON, September, 2019

Facts and Figures 2018

Sales	30.25 bn €
Adjusted EBIT[1]	3.0 bn €
Adjusted net income[1]	1.5 bn €
Investments	3.5 bn €
Dividend per share[2]	0.43 €
Employees	43,302

Adjusted EBIT[1] of our Core Businesses

Energy Networks
€ 1.8 bn

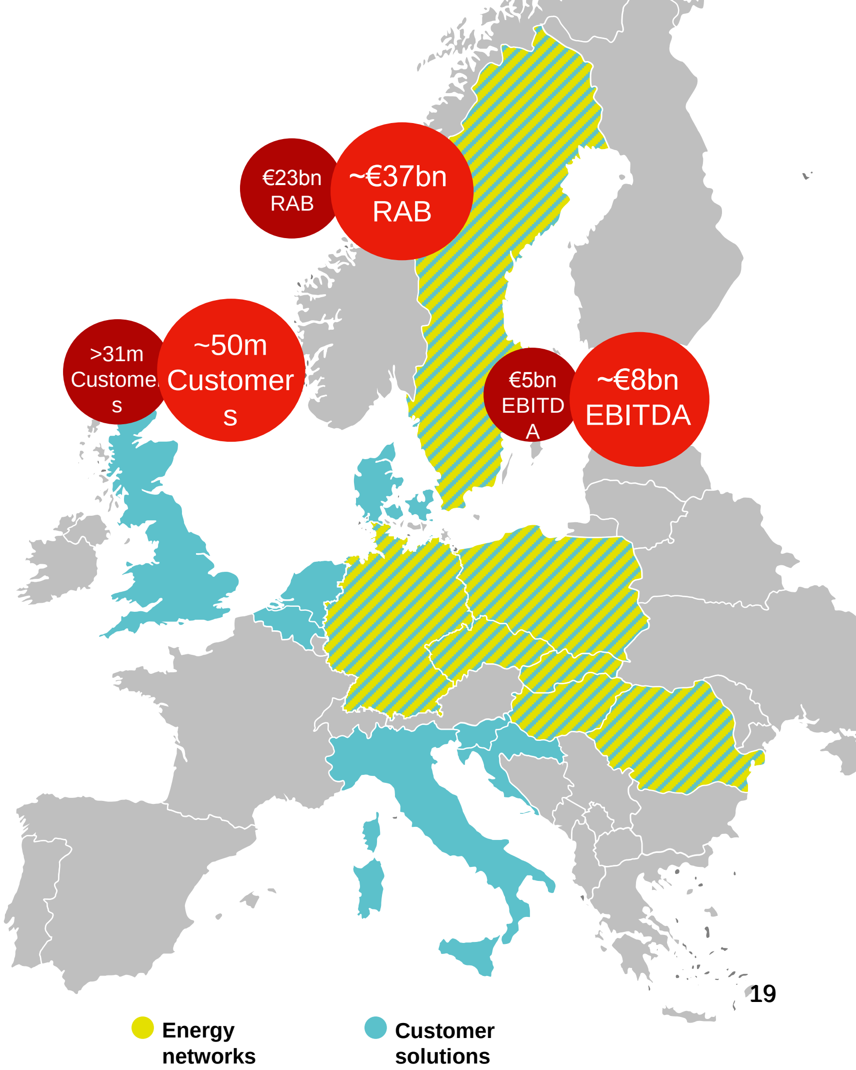
Customer Solutions
€ 0.4 bn

Renewables
€ 0.5 bn

[1] Adjusted for non-operating effects.
[2] The figure represents management's dividend proposal.

E.ON to Become the Forerunner of the Decentralized Energy World in Europe

- E.ON will have a much clearer strategic profile with intelligent networks and innovative customer solutions
- Customers will be able to rely on better and more competitive offers
- The business combination will create strong financial foundations
- Better prospects for employees will be created
- E.ON will do its utmost to ensure that Europe can successfully combine its competitive strength with a sustainable energy policy



Megatrends

- Decarbonization
- Decentralization
- Digitalization
- Democratization

❯

"The new energy world is green, digital, and distributed. Our customers expect us to provide them with innovative solutions"

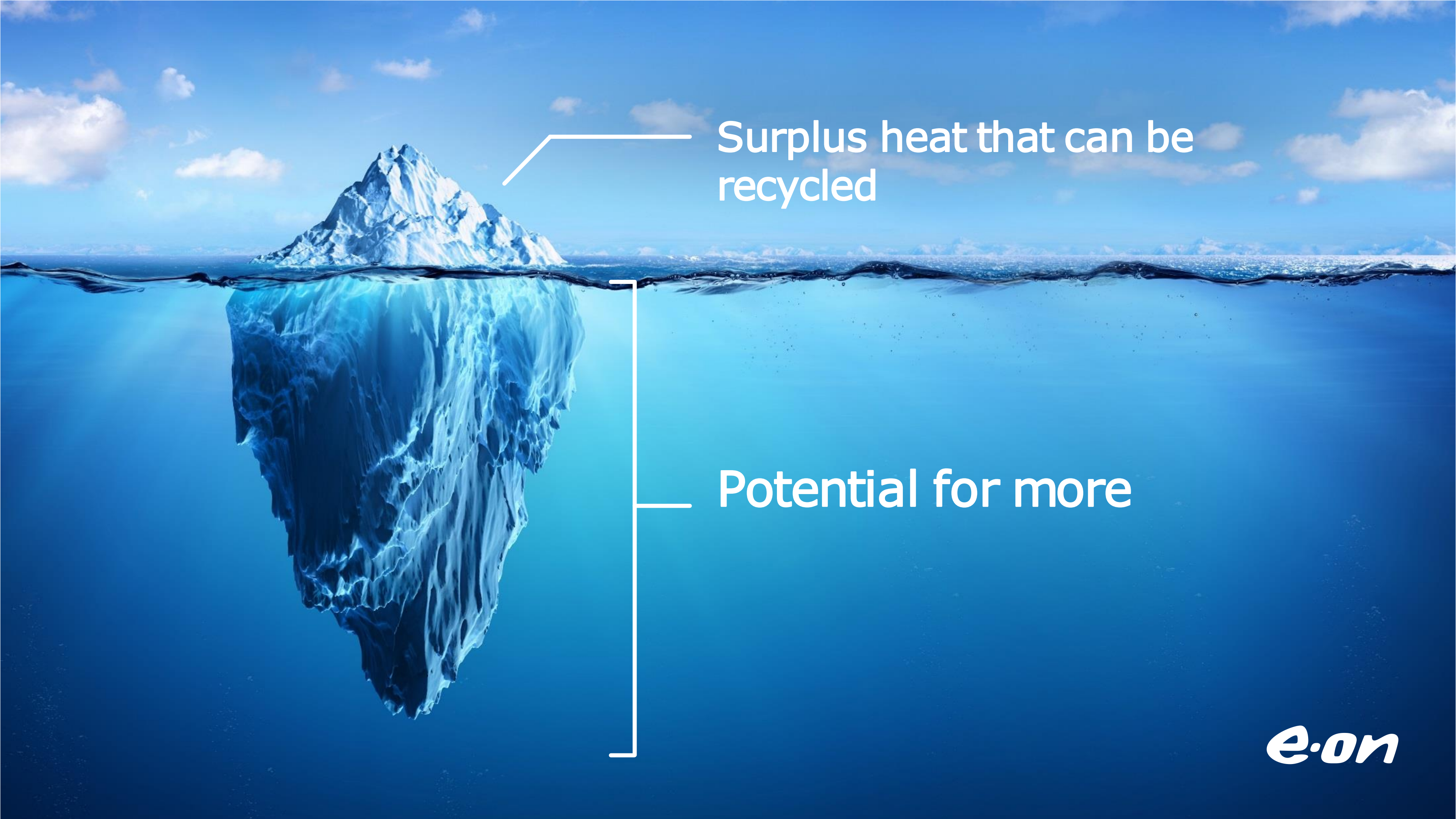
Johannes Teyssen,
CEO E.ON SE

The new energy landscape

Urbanization and sustainability are drivers in shaping the new decentral energy landscape.

The ectogrid™ technology is a key enabler for energy efficiency and reducing CO_2 emissions from heating and cooling.



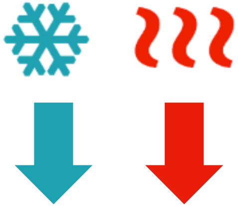

Surplus heat that can be recycled
Potential for more

Zero carbon heating and cooling

ectogrid™ - a thermal microgrid



An E.ON Innovation



35

MEDICON VILLAGE

An energy system
Developed by
Dr. Per Rosén at
Business Innovation.

35 patents pending
Strong patent
protection.

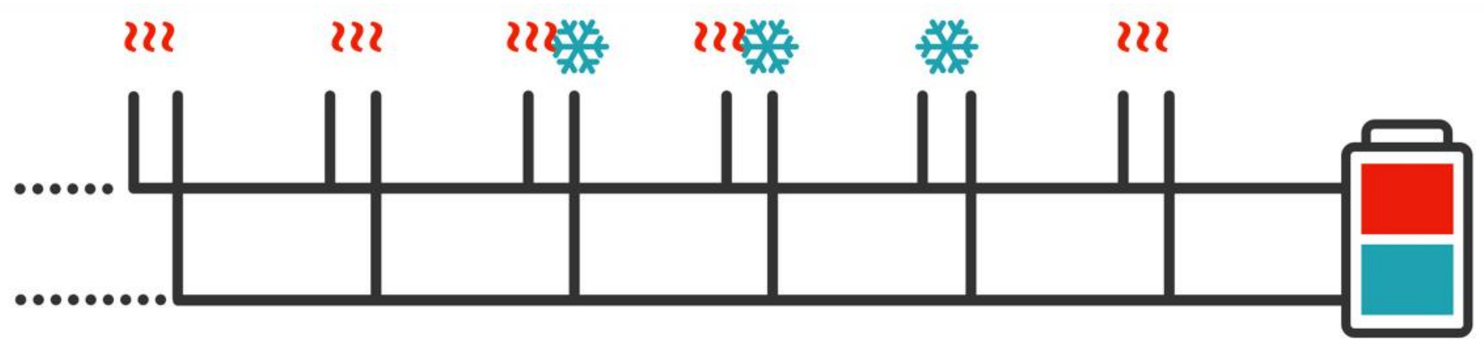
Customer focus
Concept developed in
close cooperation with a
select set of customers.

e·on

- ✓ **The most energy efficient heating and cooling solution**
- ✓ **Cheaper to build - one grid serves 2 utilitites**
- ✓ **Cheaper to operate**

How ectogrid™ works

Buildings connected to the same system provide each other with heating and cooling.



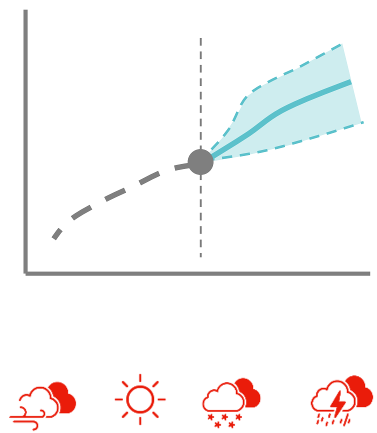
https://www.youtube.com/watch?v=okTdIG4idWg

ectocloud™

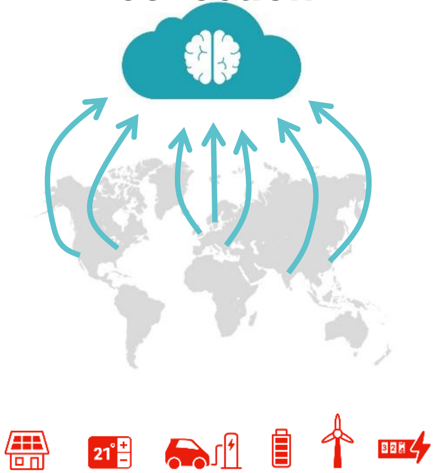


Unique ectocloud™ functionality

Forecasting



Data collection

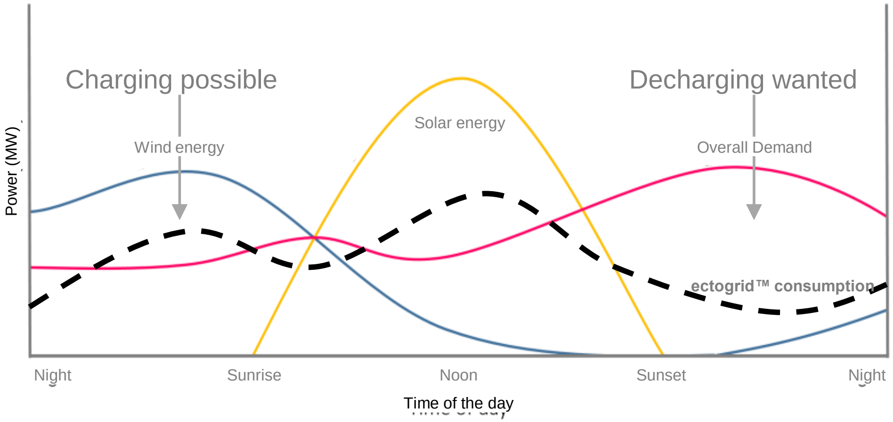


Steering



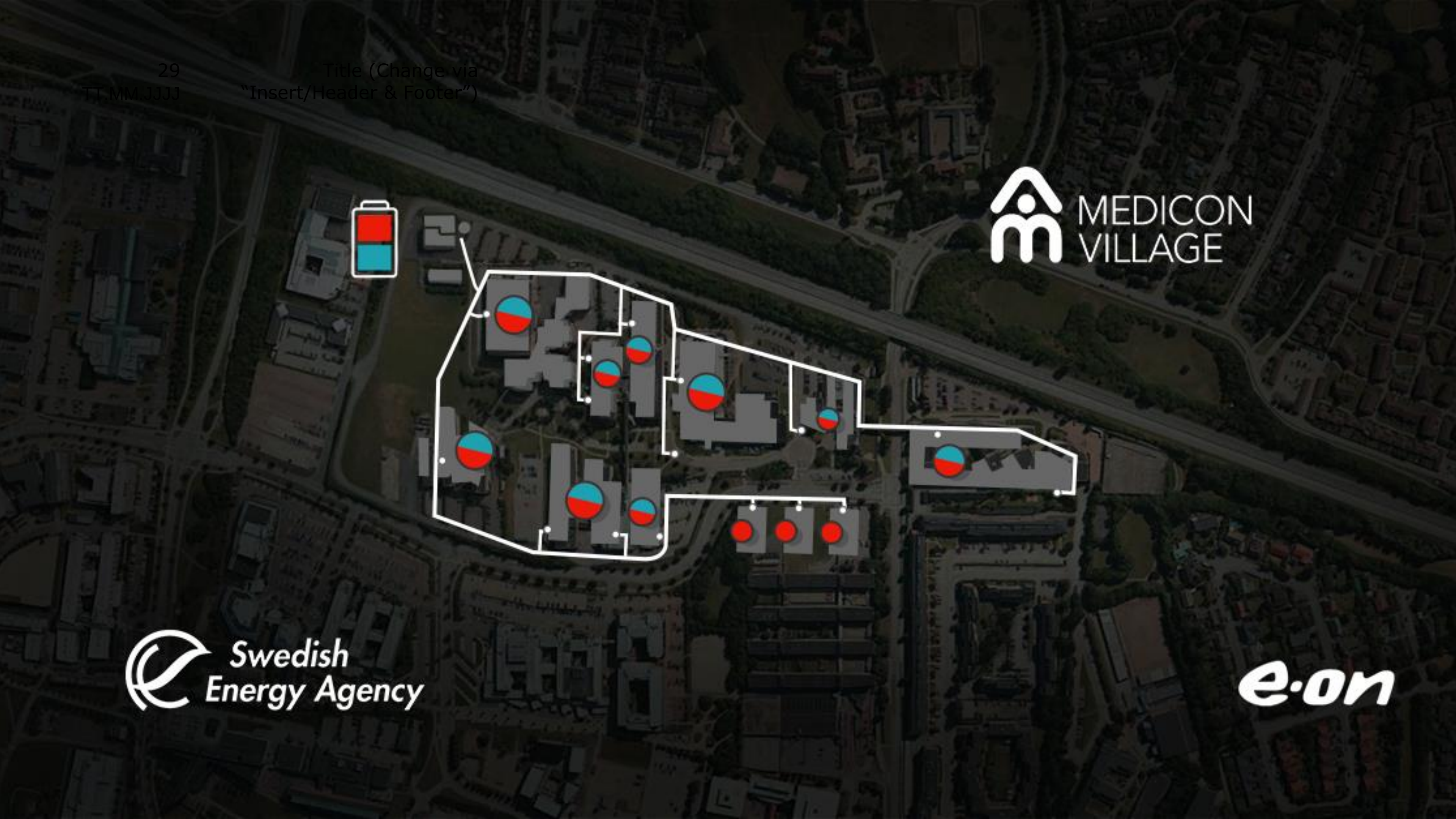
ectocloud™ creates and captures flexibility

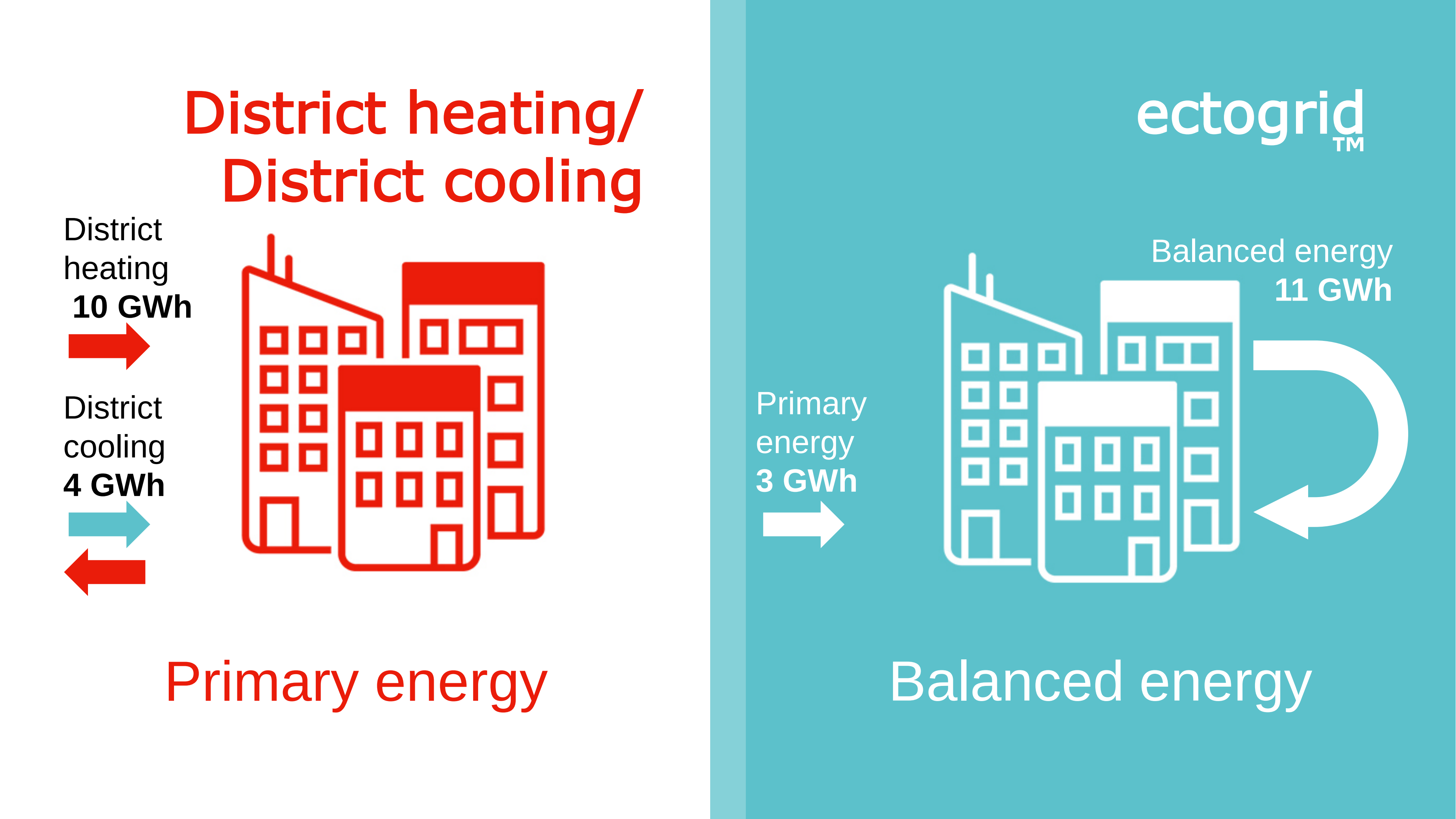
Renewable production and consumption in defined area








MEDICON
VILLAGE
Swedish
Energy Agency
e·on


District heating/
District cooling
District
heating
10 GWh
District
cooling
4 GWh
Primary energy
ectogrid™
Balanced energy
11 GWh
Primary
energy
3 GWh
Balanced energy

RESULT

ectogrid™ at Medicon Village results in a reduction of the;

Supplied Energy: -
78,5 %
Energy bill for customer -
20 %

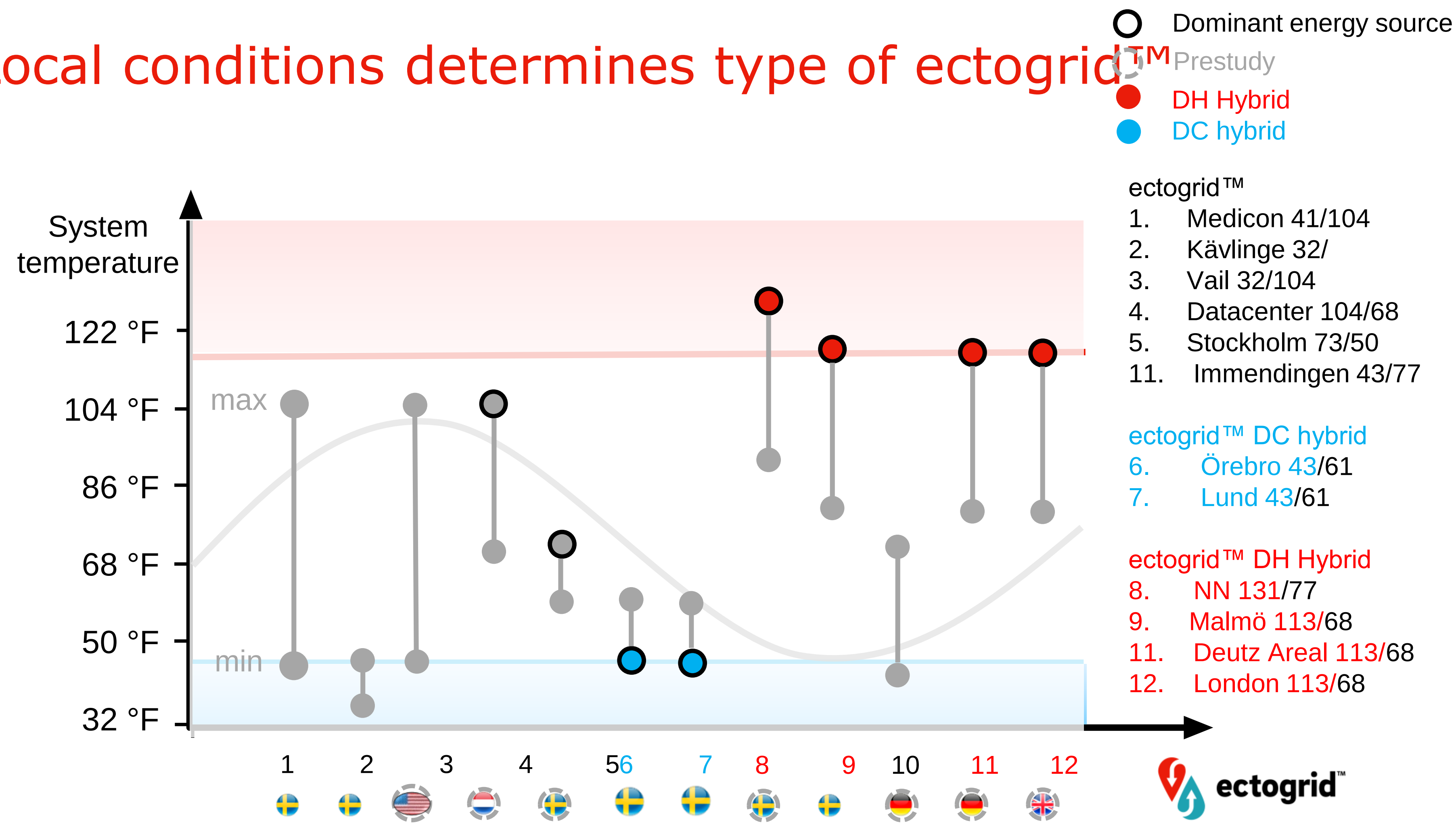
This is a zero emission energy system

ectogrid™



Balanced energy

Local conditions determines type of ectogrid™



ectogrid™
1. Medicon 41/104
2. Kävlinge 32/
3. Vail 32/104
4. Datacenter 104/68
5. Stockholm 73/50
11. Immendingen 43/77

ectogrid™ DC hybrid
6. Örebro 43/61
7. Lund 43/61

ectogrid™ DH Hybrid
8. NN 131/77
9. Malmö 113/68
11. Deutz Areal 113/68
12. London 113/68

ectogrid™

What we are looking for in the US

Innovation collaboration opportunities!!

- Innovation reference projects
  (e.g. forward leaning customers/campuses)
- Technology partners
  (market adoption and AI and optimization algorithms)
- Licensing partners
  (energy companies)

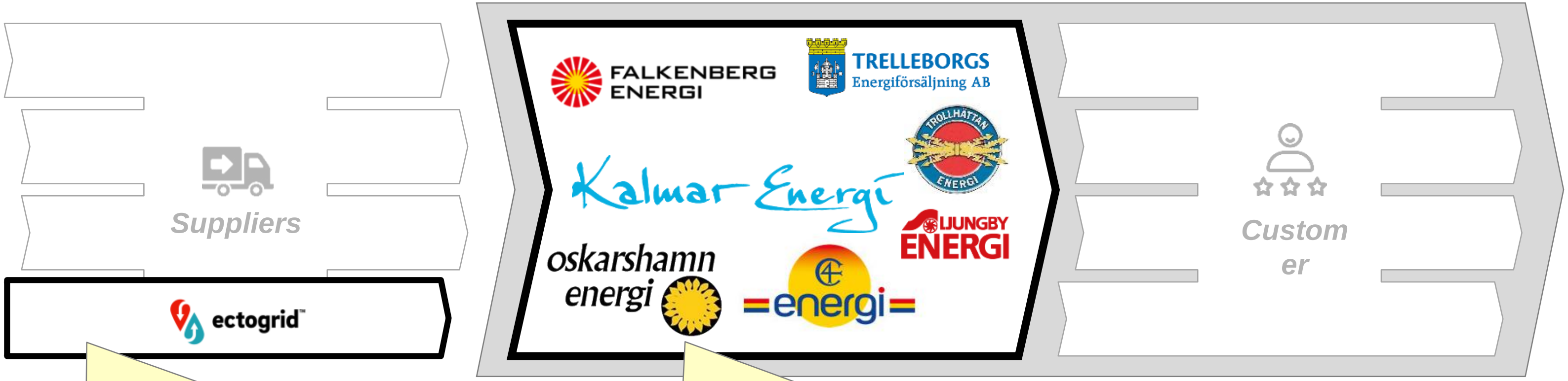
ectogrid™

More information about
the ectogrid™ technology can be found at:

www.ectogrid.com
or contact;
Maria.malm@eon.se
+46 70 222 18 54

e·on

Value Chain – licensing of IP and software



Responsibility/offer

- Owns the design concept (IPR)
- Optimization software and control
- Knowhow transfer (training)
- On request support in design phases

Responsibility

- Designs the energy solution
- Owns the relationship with the customers
- Own brand
- Pricing and business model
- Billing
- Customer interface

Thank you!

Contact:
Maria.malm@eon.se
+46 70 222 18 54



The Thermal (Energy) Highway©

GreyEdge Group

Energy *harvested*, *moved*, and *reused*

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Courtesy of The GreyEdge Group©

BENEFICIAL ELECTRIFICATION



Beneficial Electrification – What is it?

Beneficial Electrification – Pathway to Deep Decarbonization

Is a State-of-the-Art term emerging in the energy industry.

The Beneficial Electrification League states that BE includes:
The application of electricity to end-uses that would otherwise consume fossil fuels where doing so satisfies at least one of following conditions, without adversely affecting the others:

- save consumers money over time;
- benefit the environment and reduce greenhouse gas emissions;
- improve product quality or consumer quality of life; or
- foster a more robust and resilient grid.

NOT an "Electrify Everything" Concept



How Fast Can Transformation Occur?



Easter Sunday 1900, 5th Avenue,
New York City, Horse Drawn Carriages Only

Easter Sunday 1913, 5th Avenue,
New York City, Automobiles Only



Could the energy industry transform itself in only 13 years?

Some Electrification is……….



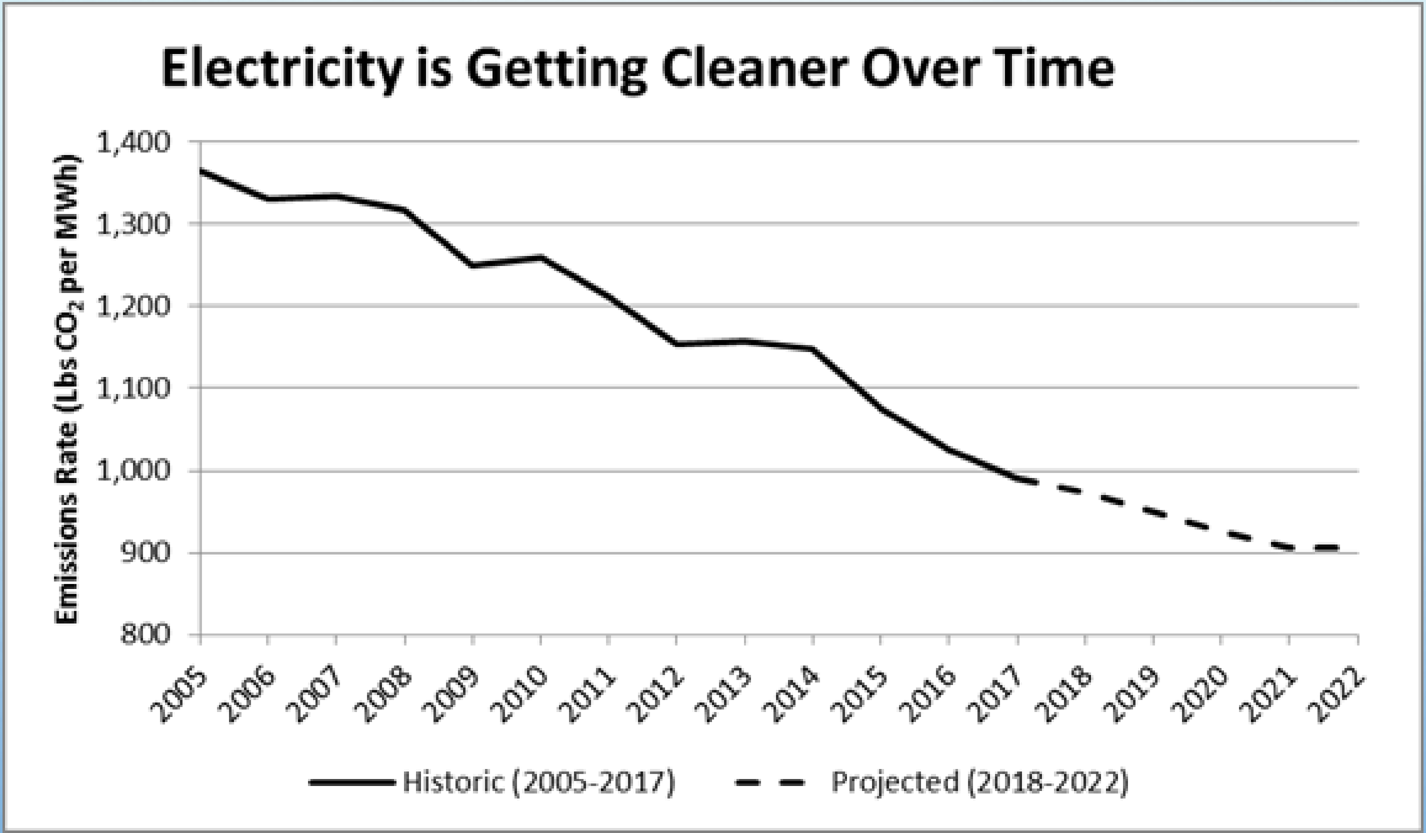


And Some is……….

What would the world look like without Electricity?

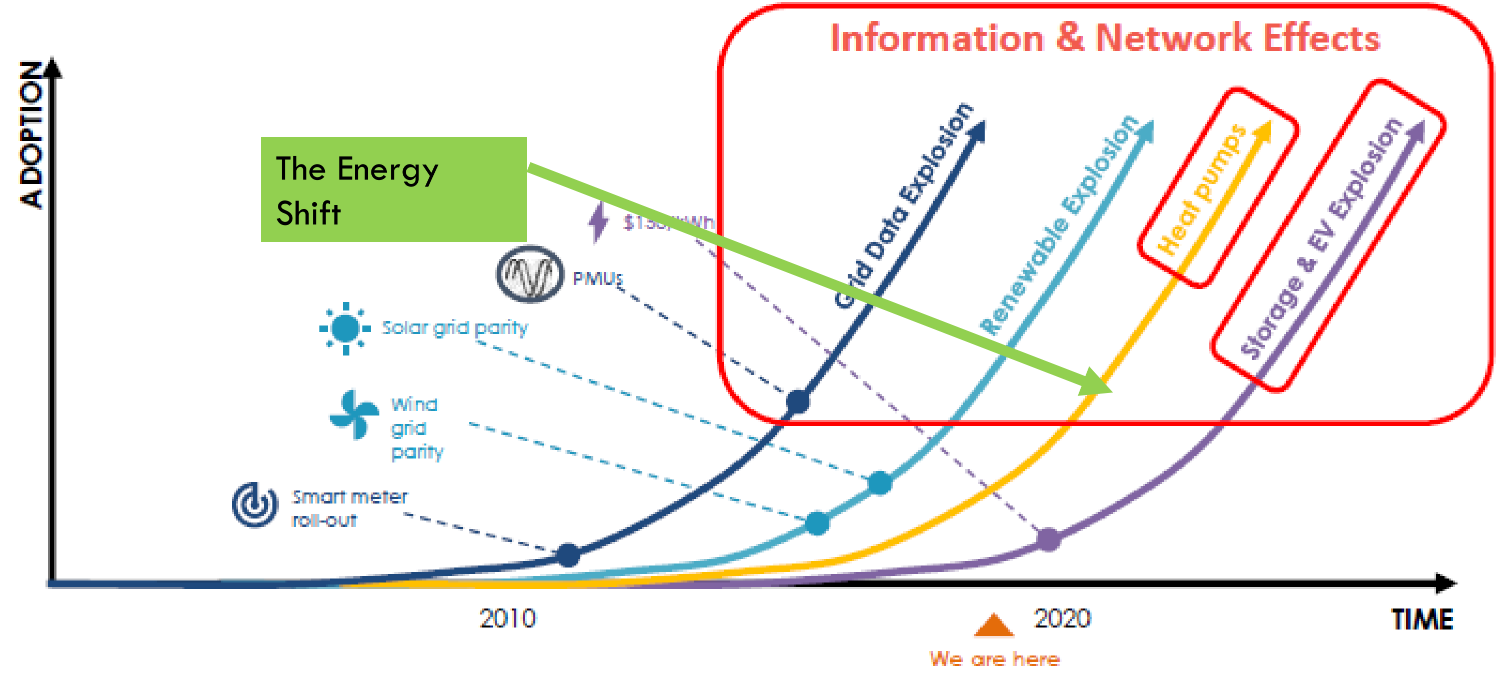
Maybe……………

https://youtu.be/vog7yDmcDNQ



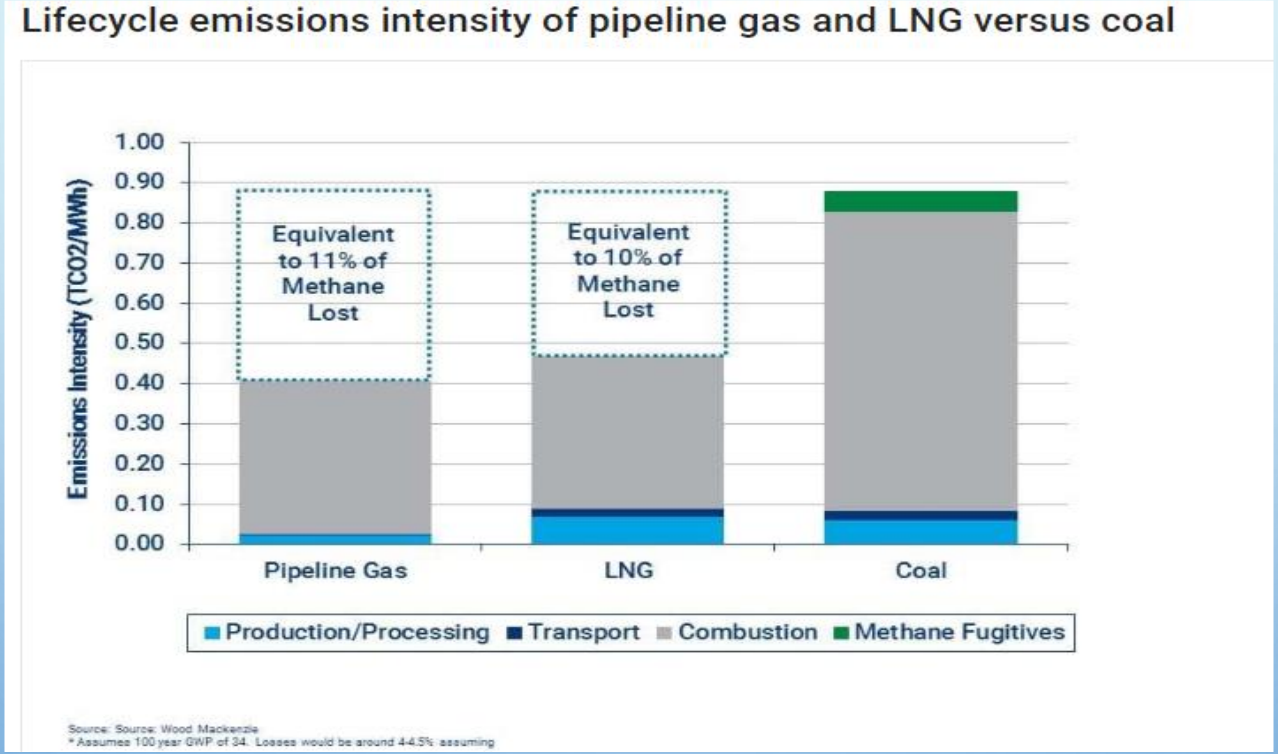
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Disruptive Forces Transforming Electricity



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Fossil Fuels are Equally Polluting



https://www.woodmac.com/news/opinion/do-fugitive-emissions-of-methane-make-natural-gas-more-emissions-intensive-than-coal/

Repurposing Natural Gas Infrastructure

The Bridge Between Gas and Electric is Geothermal Heat Pumps

Both Electrical and Natural Gas Industries Have a Chance To Cooperate In Benefiting Society And Increased Profitability

- Example: Asphalt Vs. Concrete

Natural Gas - Repurposing Of Assets, Pipelines

- Represents A Non-pipeline, Pipeline Solution
- Proven Expertise In Underground Pipe Laying
- Existing Rights-of-way And Easements
- Potential For Testing/Sleeving Or Utilization Of Existing Gas Lines As **GeoMicroDistrict** Distribution System

Beneficial Electrification – Pathway to Deep Decarbonization

The Bridge Between Gas and Electric is Geothermal Heat Pumps

1. Consumers Must Be Shown The **Advantages** Of Choosing Electric Products.

2. By Virtue Of Being Plugged Into The Grid, The Environmental Performance Of Electric Devices **Improve** Over Time.

3. Understanding **Storage** Is The Next Logical Step In The Progression Of Renewable Generation. Without The Ability To Store Energy, Renewables Will Have An Artificial Cap Placed On Their Utilization.

Example: Horses to Cars
Example: Solar Thermal: Molten salt represents ¾ of worlds off peak energy storage.
https://www.greentechmedia.com/articles/read/will-molten-salt-outdo-batteries-for-grid-tied-storage#gs.9o7tox

Beneficial Electrification – Pathway to Deep Decarbonization

The Energy Industry Is Undergoing Tremendous Changes.

Additional Time Will Be Required To Retrofit Power Generation Plants And Develop New **Storage** And **Transportation** Technologies.

However, We Can Begin Implementing Deep Decarbonization Strategies Immediately With The Adoption and City-Scale Deployment Of:

- **GeoMicroDistrict**
- **Community Convective Circulation Circuits©** (4 C's)
- **Thermal Highway©**

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csmith@greyedgegroup.com

Questions?

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Courtesy of The GreyEdge Group© & HEETMA

State-wide Energy Transition Example

Jerry Acton

Combustion Fuels Approach 1990 - 2015

- GHG Emissions Goals <u>Cannot Be Achieved</u>

  By Simply:

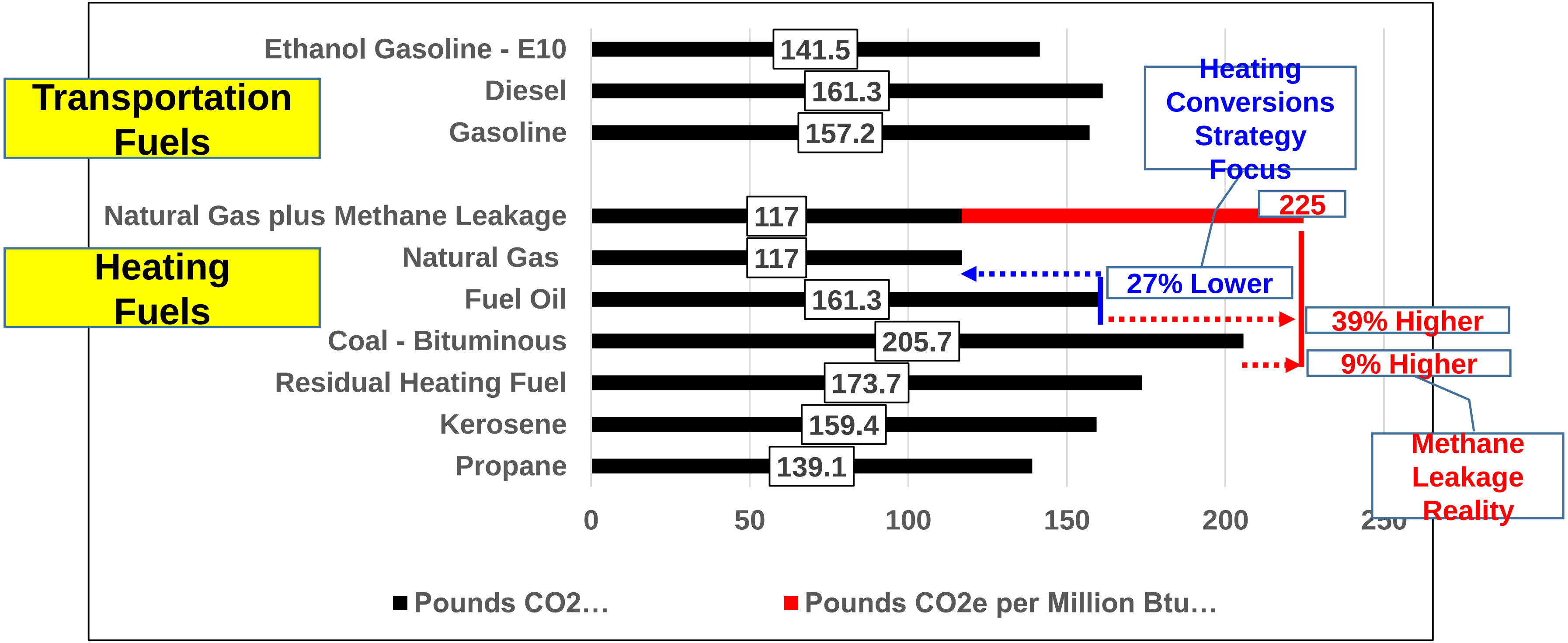
  - Switching Combustion Fuels
  - Incrementally Improving Vehicle Emissions

Conversion to Cleaner Diesel and Natural Gas Saves 100's of Lives/Year

- Good CO_2 Reduction in 3 of 5 Sectors — **CO_2 Down 19%**
- CO_2 Progress Offset by Methane Leakage — **GHG Down 6%**
- Combustion Energy Use Decreased — **Down 7.8%**
- Lost Energy Down Very Little — **Down 1.5%**
- Total Energy Use Down Very Little — **Down 0.2%**
- Energy Efficiency Negligible Improvement — **Up 0.5%**

Marginal Overall Progress After 25 Years

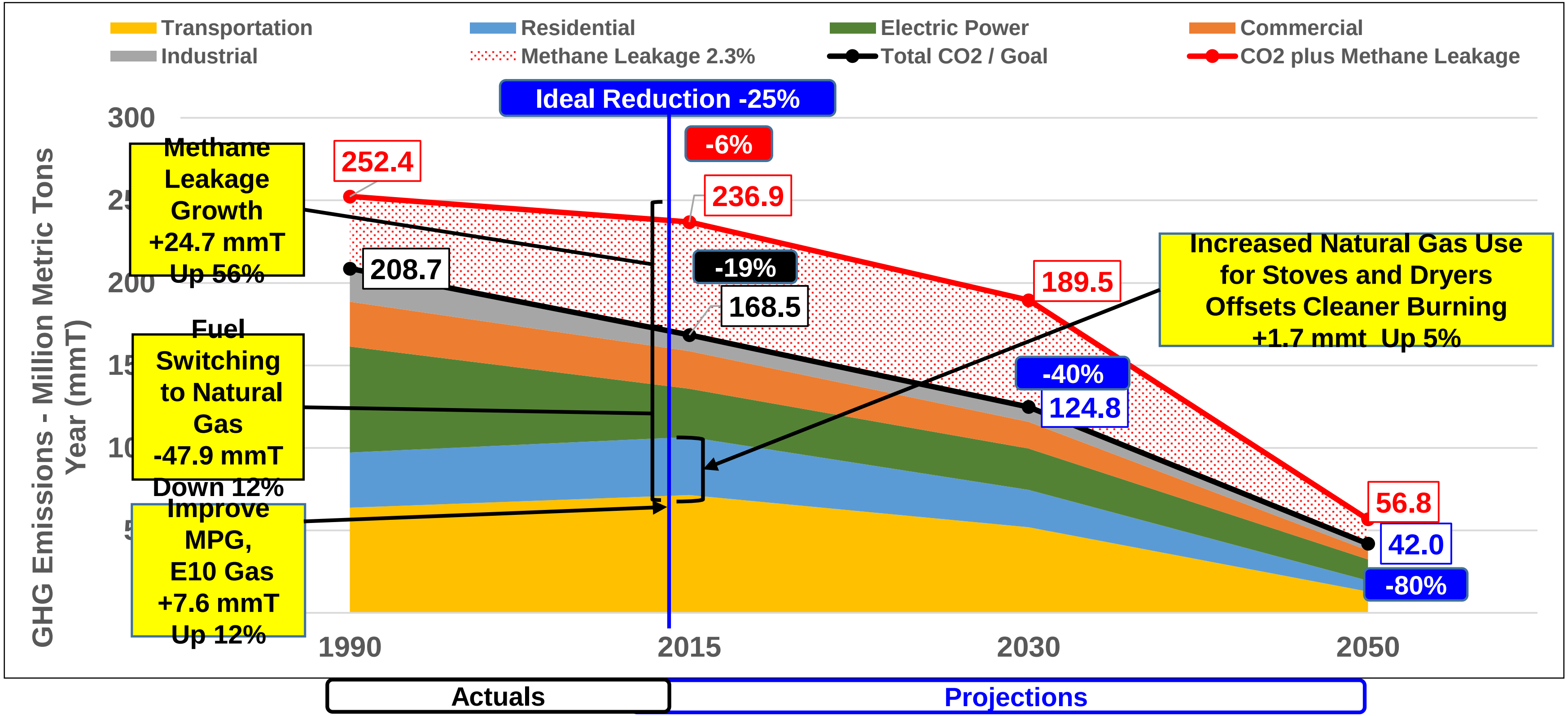
GHG Emissions for Fuels
(Pounds CO2e / Million Btu) including 2.3% Methane Leakage



When Properly Accounting for Methane Leakage, Natural Gas GHG Emissions are <u>Higher than All Other Fuels</u>

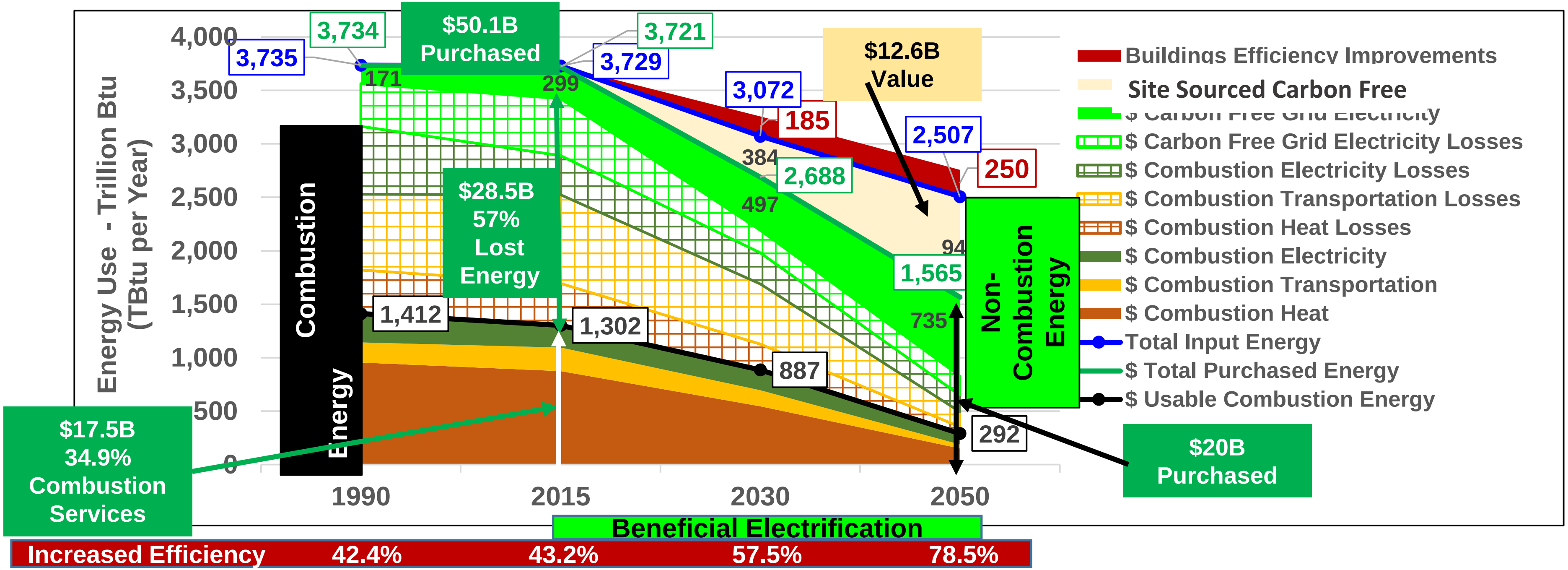
Source: www.eia.gov/environment/emissions/co2_vol_mass.php

GHG Emissions Reduction Timeline By Sector 1990 - 2050



Residential and Transportation Increasing as of 2015
Electric Power, Commercial, & Industrial Sectors Compensate
Goal is All Sectors Meet -80% by 2050

Energy Use Transition 1990 - 2050 (Trillion Btu)



Ratepayers Are Captive to Combustion Energy:
emissions intensive, expensive, wasteful, unhealthy
We Can Do Better

Convert to Grid and On-site Carbon Free Energy

- **Lower Emissions**
- **Higher Efficiency**
- **Lower Energy Use**
- **Lower $ Cost**

Why Are We Still Investing in Combustion Energy?

Source: Consumption Data: https://www.eia.gov/state/seds/seds-data-complete.php?sid=NY

Large Scale Beneficial Electrification Required

- **40% GHG Emissions Reduction by 2030**

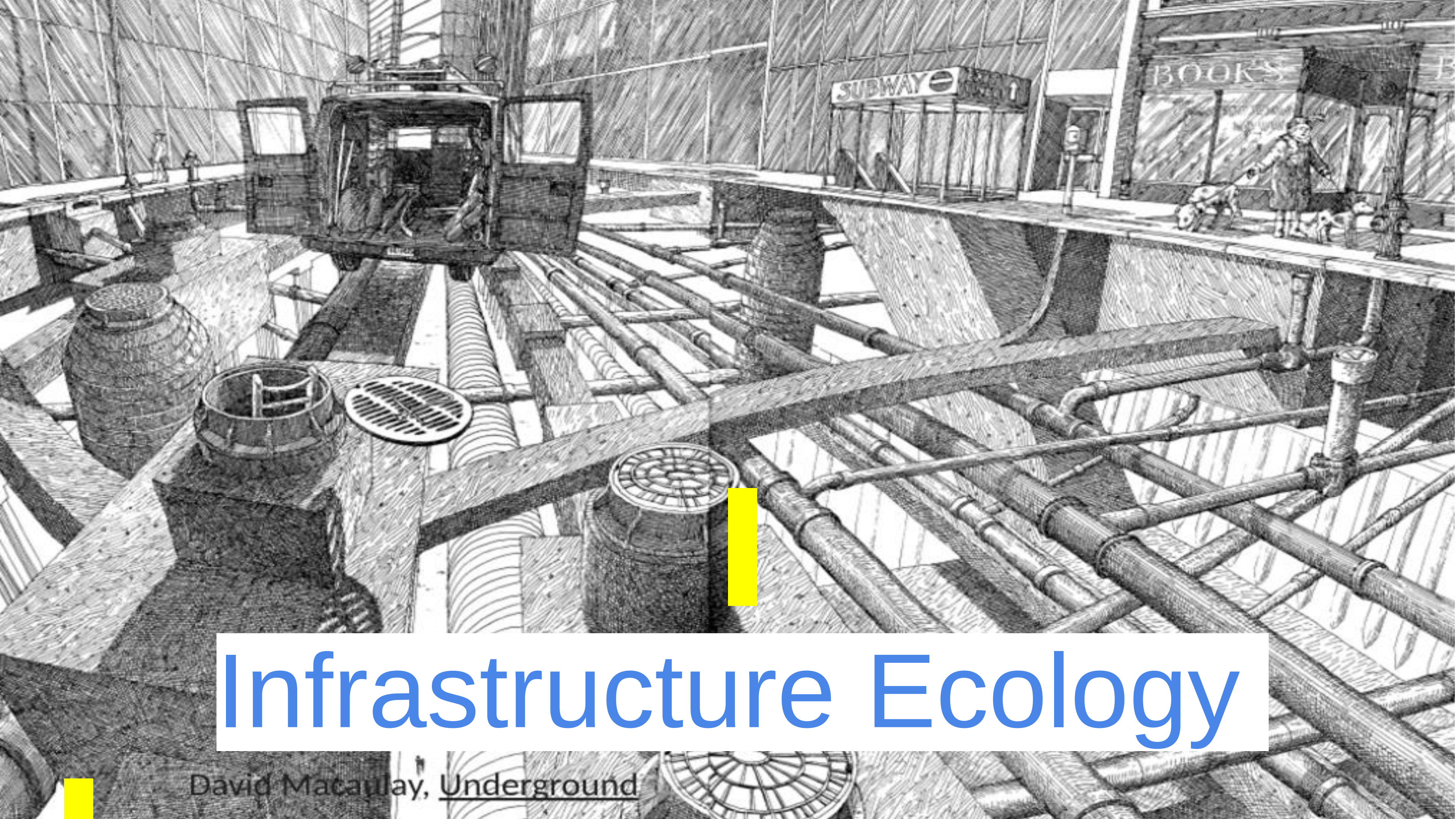
  Requires Significant Conversions / Additions:
  - **3.3 Million Battery Electric Vehicles** — **220,000 per Year**
  - **3.5 Million Housing Unit Heat Pumps** — **233,000 per Year**
  - **40% Commercial, Industrial Buildings with Heat Pumps** — **27,000 per Year**
  - **82.1 Terra-Watt Hours of Carbon Free Electric Power** — **5.5 TWh per Year**

- **80% GHG Emissions Reduction by 2050**

  Requires Additional Conversions / Additions of:
  - **5.2 Million Battery Electric Vehicles** — **260,000 per Year**
  - **3 Million Housing Unit Heat Pumps** — **150,000 per Year**
  - **80% Commercial, Industrial Buildings with Heat Pumps** — **20,250 per Year**
  - **86.3 Terra-Watt Hours of Carbon Free Electric Power** — **4.3 TWh per Year**

Current Pace of System Conversions Must be Increased by 3-6 Times

Infrastructure Ecology



David Macaulay, Underground

When Systems Collide



When Systems Collide

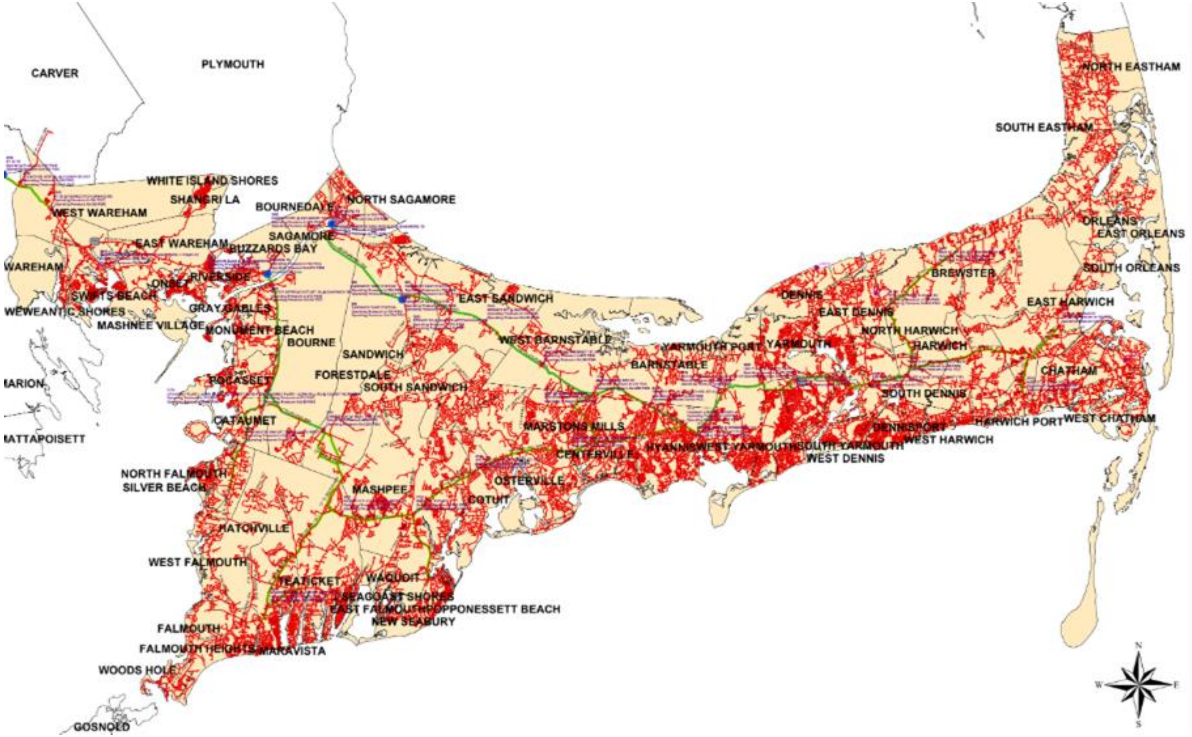


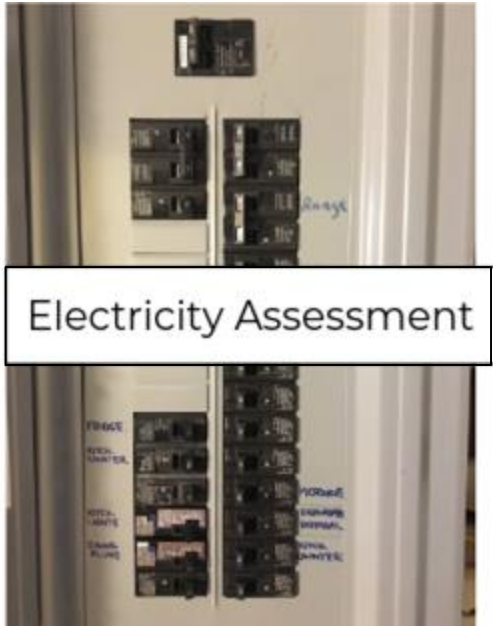
Systems Under Pressure



Atlantic Avenue closed
by flooding on March 2nd in front of Aquarium MBTA Station

Single Point Failures & Backup Capacity





heet

COFFEE BREAK !!!

Please Add Your Thoughts to:

Shared Language & Pilot Site Criteria

Shared Language

&

Site Criteria Discussion

Convening the System to Build Utility-Scale Geothermal Networks

PLENARY SESSION: What's Next?















